

# Volatile Organic Compounds Emissions

## Q: What are the trends in outdoor air quality and their effects on human health and the environment?

The above question pertains to all 'Outdoor Air' Indicators, however, the information on these pages (overview, graphics, references and metadata) relates specifically to "Volatile Organic Compounds Emissions". Use the right side drop list to view the other related indicators on this question.

### Introduction

Volatile organic compounds (VOCs) are a large group of organic chemicals that include any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) and that participate in atmospheric photochemical reactions. VOCs are of interest in part because they contribute to ozone formation (U.S. EPA, 2003a). Ozone (the [Ozone Concentrations indicator](#)) is formed from chemical reactions involving airborne VOCs, airborne nitrogen oxides, and sunlight. VOCs are also of interest because many individual VOCs are known to be harmful to human health (the [Benzene Concentrations indicator](#); the [Air Toxics Emissions indicator](#)). Health effects vary by pollutant. VOCs are emitted from a variety of sources, including motor vehicles, chemical manufacturing facilities, refineries, factories, consumer and commercial products, and natural (biogenic) sources (mainly trees) (U.S. EPA, 2003b).

This indicator presents VOC emissions from traditionally inventoried anthropogenic source categories: (1) "Fuel combustion," which includes emissions from coal-, gas-, and oil-fired power plants and industrial, commercial, and institutional sources, as well as residential heaters and boilers; (2) "Other industrial processes," which includes chemical production, petroleum refining, metals production, and processes other than fuel combustion; (3) "On-road vehicles," which includes cars, trucks, buses, and motorcycles; and (4) "Nonroad vehicles and engines," such as farm and construction equipment, lawnmowers, chainsaws, boats, ships, snowmobiles, aircraft, and others. The indicator also includes estimates of biogenic VOC emissions in 2002. Biogenic emissions were estimated using the Biogenic Emissions Inventory System Model, Version 3.12, with data from the Biogenic Emissions Landcover Database and 2001 annual meteorological data.

VOC emissions data are tracked by the National Emissions Inventory (NEI). The NEI is a composite of data from many different sources, including industry and numerous state, tribal, and local agencies. Different data sources use different data collection methods, and many of the emissions data are based on estimates rather than actual measurements. For most fuel combustion sources and industrial sources, emissions are estimated using emission factors. Emissions from on-road and nonroad sources were estimated using EPA-approved modeling approaches (U.S. EPA, 2008).

NEI data have been collected since 1990 and cover all 50 states and their counties, D.C., the U.S. territories of Puerto Rico and Virgin Islands, and some of the territories of federally recognized American Indian nations. Data are presented only for 1990, from 1996 to 2002, and for 2005. Data are available from 1991 to 1995 and from 2003 to 2004, but these data have not been updated to be comparable to the more recent inventories from 1990, 1996 to 2002, and 2005.

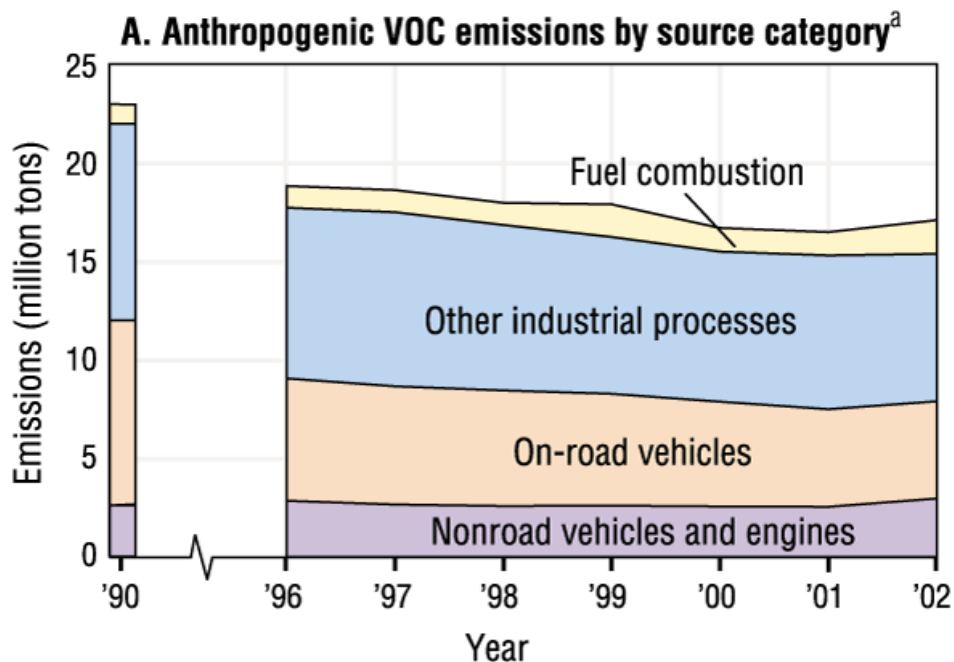
### What The Data Show

This indicator focuses on trends in VOC emissions from anthropogenic sources. However, VOC emissions from biogenic sources were estimated for 2005 to provide a sense of the relative contributions of natural versus anthropogenic emissions. Nationally, biogenic emissions were estimated to contribute approximately 74 percent to VOC emissions from all sources during 2005 (Exhibit 2-11, panel B). Thus, VOC emissions from biogenic sources are larger than the VOC emissions from all anthropogenic sources combined.

According to NEI data, national total estimated VOC emissions from anthropogenic sources, excluding wildfires and prescribed burns, decreased by 35 percent between 1990 and 2005 (from 23,048,000 to 15,047,000 tons) (Exhibit 2-11, panel A). The overwhelming majority of anthropogenic emissions reductions were observed among industrial processes and on-road mobile sources. Combined, these two source categories accounted for 84 percent of the total nationwide estimated anthropogenic VOC emissions in 1990 (excluding wildfires and prescribed burns), but accounted for only 76 percent of the nationwide anthropogenic emissions in 2005.

Trends in estimated anthropogenic VOC emissions in all ten EPA Regions were consistent with the overall decline seen nationally from 1990 to 2005 (Exhibit 2-12). Changes in VOC emissions ranged from a 7 percent reduction (Region 10) to a 54 percent reduction (Region 9).

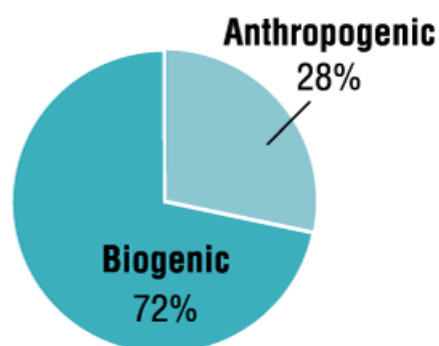
## Exhibit 2-11. VOC emissions in the U.S. by source category, 1990 and 1996-2002



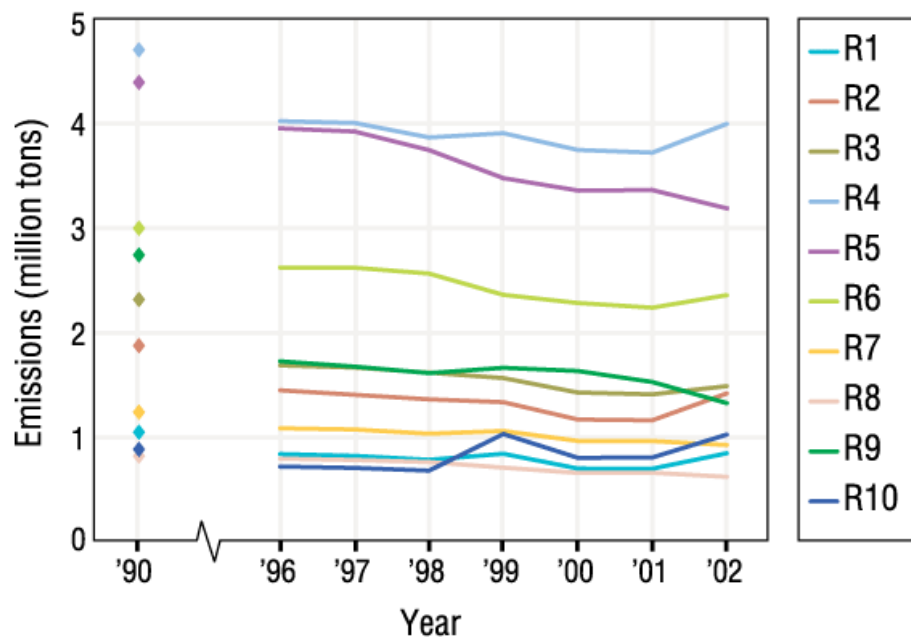
<sup>a</sup>Data are presented for 1990 and 1996-2002, as datasets from these inventory years are fully up to date. Data are available for inventory years 1991-1995, but these data have not been updated to allow comparison with data from 1990 and 1996-2002.

**Data source:** U.S. EPA, 2007b

### B. Relative amounts of VOC emissions from anthropogenic and biogenic sources, 2002



## Exhibit 2-12. VOC emissions in the U.S. by EPA Region, 1990 and 1996-2002<sup>a</sup>



<sup>a</sup>Data are presented for 1990 and 1996-2002, as datasets from these inventory years are fully up to date. Data are available for inventory years 1991-1995, but these data have not been updated to allow comparison with data from 1990 and 1996-2002.

**Data source:** U.S. EPA, 2007b



### Limitations

- Comparable VOC emissions estimates through the NEI are available only for 1990, 1996-2002, and 2005. Data for 1991-1995 and 2003-2004 are not provided due to differences in emissions estimation methodologies from other inventory years, which could lead to improper trend assessments.
- VOC emissions from “miscellaneous sources” are not included in the total emissions. Details on emissions from miscellaneous sources can be found by downloading NEI inventory data for the “nonpoint sector” (<http://www.epa.gov/ttn/chief/eiinformation.html>).
- VOC emissions data are largely based on estimates that employ emission factors generated from empirical and engineering studies, rather than on actual measurements of VOC emissions. These estimates are generated using well-established approaches, and quality assurance measures are implemented to ensure that the emissions data entered in NEI meet data quality standards (U.S. EPA, 2006). Nonetheless, the estimates have uncertainties inherent in the emission factors and emissions models used to represent sources for which emissions have not been directly measured.

- The methodology for estimating emissions is continually reviewed and is subject to revision. Trend data prior to any revisions must be considered in the context of those changes.
- Not all states and local agencies provide the same data or level of detail for a given year.

#### **Data Sources**

Summary data in this indicator were provided by EPA's Office of Air Quality Planning and Standards, based on biogenic and anthropogenic VOC emissions data in the NEI. The most recent data are taken from Version 2.0 of the 2005 NEI (U.S. EPA, 2009). These and earlier emissions data can be accessed from EPA's emission inventory Web site (<http://www.epa.gov/ttn/chief/eiinformation.html>). This indicator aggregates NEI data by source type (anthropogenic or biogenic), source category, and EPA Region.

#### **References**

- U.S. EPA (United States Environmental Protection Agency). 2009. Data from the National Emissions Inventory, Version 2.0. Accessed 2009. <http://www.epa.gov/ttn/chief/eiinformation.html>
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- U.S. EPA. 2006. NEI quality assurance and data augmentation for point sources. Research Triangle Park, NC. [ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/point/augmentation\\_point/2002nei\\_qa\\_augmentation\\_report0206.pdf](ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/point/augmentation_point/2002nei_qa_augmentation_report0206.pdf)
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